The Great Workshop of Science

The Filipinos Blow Their Own Bottles Now

BECAUSE of the war inflated prices of the imported variety, in the Philippines they are about to begin the manufacture of their own glassware. "The Philippine Review," in reporting recent experiments by the Bureau of Science, states that all the required materials are to be had at home.

"The necessary ingredients for this manufacture are white sand or silica, which is found in large deposits in the island of Lubang, near Mindoro, and undoubtedly in many other regions of the Archipelago; limestone, which is available in large quantities in Binangonan and Montalban, and in other parts of the islands; soda ash or sodium carbonate, which is imported, but which may be produced in the islands, provided the salt industry is developed, and metallic oxide, which is used for coloring the glass, and of which Ilocos Norte produces manganese.

"The experiments held in the Bureau of Science at 3:30 p. m., on June 12, have demonstrated that this industry is in the embryo stage. Dr. Timoteo Dar Juan, a chemist in the bureau, was in charge of the experiments. A Japanese expert blower conducted the demonstration, which was indeed interesting. Certain quantities of finely ground white sand or silica, limestone, and soda ash or sodium carbonate—in varying proportions according to the kind of glass desired to be manufactured—are mixed into batch with great nicety, knowledge and skill. A small amount of metallic oxide is also mixed to produce the desired color; thus, the combination of manganese, found in Ilocos Norte, produces green color. The batch, the mixture of the materials whose chemical combination, brought about by heat, produces glass, is placed in the furnace and subjected to heat approximately 1,500 to 1,800 centigrades, until it becomes molten glass, which is highly viscous. While in this condition it is gathered up in a soft mass at the end of a glass tube, and the lump, fire-red, by blowing through the tube, is distended into a hollow sphere. It is then thrust into an iron receptacle containing a small quantity of mineral oil to smoothen its surface. The form of this sphere or bulb is then modified by a skilful manipulation of the glass tube. By different processes, infinitely diversified and complicated by the skill of the workmen and the nature of the product, the desired result is obtained. In order to obtain a required pattern, the bulb, while in plastic condition, is placed in a mould and blown in through the tube. The shape is rendered permanent by cooling. The neck of the bottle is then fixed, and the finished product is covered by ashes of burned straw in order to cool it off gradually. The melting furnace has working furnaces called 'glory holes,' where the glassworker reheats his work."

Increasing the Range of the Big Guns

"LA NATURE," of Paris, has been publishing a series of articles dealing with the possibilities of development of long-range guns. In its last issue M. H. Volta points out the way in which the range of guns can be increased. He says:

"One of the first means for increasing the range of guns was suggested in 1880 by Lyman, who invented an 'accelerated cannon' with the aid of which he believed it would be possible to obtain a speed sufficient to considerably increase the power of the projectile. Time powder was not yet known. In order to obtain a great central speed of the projectile it is necessary to produce very great pressure in the interior of the cannon. But as soon as the shell begins to leave the tube the pressure is continually decreasing, and at the mouth of the tube it has only a fraction of the original pressure. The result is that a great part of the propelling force is lost at the start.

"Figure 1 illustrates the distribution of pressure in the interior of a gun, firstly, in

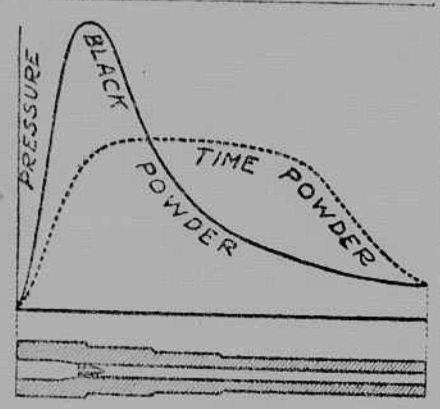


Fig. 1. The curve of pressure within the bore of a cannon, charged with black powder or with time powder

the case when use is made of black powder, which explodes instantaneously, and, secondly, when time powder is used. In the second case, as can easily be seen, the maximum pressure is not as high as in the first, but instead of instantaneously decreasing, as in the case of black powder, it retains almost the same force and in the end it gives the projectile greater energy. Nevertheless, in both cases the force which acts upon the projectile is not very great. Lyman tried to remedy this fault by means of a cannon with a multiple charge, shown in Figure 2. As the projectile moves through the tube of the cannon it sets afire the powder in the pockets, which gives it new force.

"Lyman and Haskell expected to attain a speed of 1,500 yards per second, which was considerable for that period, but the experiments did not confirm their expectations and they could not get higher speed than 500 yards per second while consuming eighty-four pounds of powder. Their ideas were correct, but their failure was due to the irregularity of the combustion of the powder employed and the insufficient length of the cannon to benefit from the additional force.

"Lyman tried to remedy the first of these

Fig. 2. Lyman cannon, with multiple powder chambers

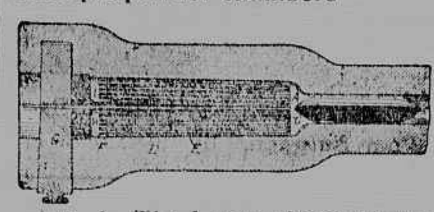


Fig. 3 The Lyman Haskell perforated cartridge

causes, as the second one was of a metallurgic character and the construction of a long gun even in those days was a very difficult problem. He invented a cartridge resembling somewhat the modern cannon cartridge of our guns of large calibre.

"Figure 3 illustrates the principle of that cartridge: The powder is introduced into the cartridge in plastic form and is then perforated by a number of holes, as is indicated in the illustration. The powder is set afire through the central hole and explodes first along the interior surface of each of the walls of the holes. This surface is relatively small at the beginning, and as combustion goes on the diameter of the tubes catching fire increases and at the same time the surface involved; as the quantity of the burning powder increases so does the pressure on the projectile. And so the main problem lies in the regulation of the number and the diameter of the holes, so that the total amount of the powder be burned up before the projectile leaves the cannon.

"This way of arranging the powder is

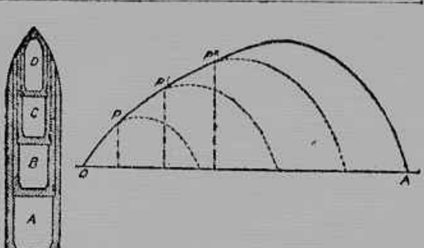


Fig. 4. The many chambered shell, with its supposed path

employed in modern cannon charged not with black powder, but with colloidal powder that can be easily moulded.

"So much for the historical side. Now let us see the means the Germans could have employed in their long-range gun. Three hypotheses have been made: the multiple-chambered shell, the theoretical construction and the range of which is illustrated in Figure 4; a cannon firing a 'sub-calibre' shell; finally, an ordinary cannon with the powder chamber and barrel resembling those of ordinary guns, but considerably larger.

"As to the multiple-chambered shell, which has three or four sections, no good results have been obtained from it, and here are reasons: The projectile is supposed to function in the following manner: the entire compound shell, as seen in Figure 4, is hurled by the cannon from point O and reaches point P, where the powder in chamber A is set afire by a time fuse; the external shell then acts as a mortar and its force carries the compound shell B C D to point P-1; then the same process is repeated, and shell C D is carried to point P-2 by the explosion in section B, and thus, finally, section D of the shell reaches its point of destination A.

"Fortunately the results are not doubtful. Without even asking ourselves how it is possible that a series of fuses can be directed with any amount of precision at a

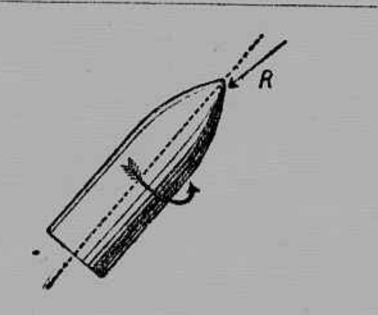


Fig. 5. The resistance of the air producing an *R* inclined along the surface

height of from 20 to 50 kilometres, it is sufficient to think of the various contrary forces that may act upon the shell in changing its course. Among the factors that interest us is the action of the air upon the ogive of the projectile. In this connection we call attention to the fact that when a certain external force acts upon a gyroscope, i. e., a body in rapid rotation on its axis, the movement which results is called *precession of the axis*, i. e., the axis describes a cone around its normal position.

"Now, the air which strikes a projectile in motion at a given moment produces a resultant R, which is directed, for example, as indicated in Figure 5. This force does not affect the centre of gravity of the projectile. As the projectile is all the time in rapid rotation there is a *precession* of the axis, which makes the shell turn around a new axis that goes through its old centre of gravity, but parallel to the external force. But as soon as the movement ceases the direction of the force of the air also changes, and a movement of precession results along a different axis. Consequently the projectile will go through a series of oscillating movements and will describe in the air a series of scallops, which will follow the curve illustrated in Figure 6.

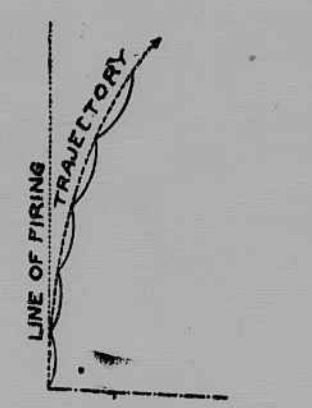


Fig. 6. The scalloped curve produced by the point of the ogive

"Now, it can be easily understood that it would be practically impossible to aim the shell at any definite point, as the various time fuses of the many-chambered shell act independently from the direction which the axis of the shell assumes at a given moment. It would be impossible to take a definite aim even if it were as large as the city of Paris.

"It is Hudson Maxim who was the first one to come out with the hypothesis of the existence of a German gun firing a 'sub-calibre' shell.

"Let us take, for example, a 380 howitzer capable of firing a shell weighing 2,200 pounds with an initial speed of 648 yards per second, and let us load with a projectile whose diameter is half that of the bore of the gun and which is held in the cannon by two guides that leave it as the projectile emerges from the muzzle of the cannon. This is shown in Figure 7.

"As the weight of this shell is supposed to be about a fourth of that of the shell normally fired by the cannon, the speed which the same charge of powder would give it would have to be much greater, for example, more than 2,160 yards per second, provided that the powder could burn four times as rapidly as the one previously employed. The shell would be provided in the back part with a cone-shaped attachment consisting of four pieces and capable of receiving the pressure of the explosive gas, and in the front part with a ring consisting also of four pieces; all these pieces would fall apart from the shell as soon as it left the cannon, which keeps them together. Now, even if we should admit that it would be possible to construct such a shell, the powder above mentioned would also have to be produced, and there are no indications whatever that even then the cannon could be employed.

"The most probable solution is the last one which we shall consider—a cannon with a new tube inside covering the entire length of the bore, as illustrated in Figure 8. At the same time the combustion chamber of the retubed cannon would remain the same as before; thus its dimensions would be very considerable as compared to a gun that fires shells of the same size as those that would be fired through the new bore; in this way, too, the maximum utilization would be made of the force of the powder which is expressed in 'calibres.'

"Let me give a concrete example. Let us take a Krupp naval gun of the type used on the large German vessels which

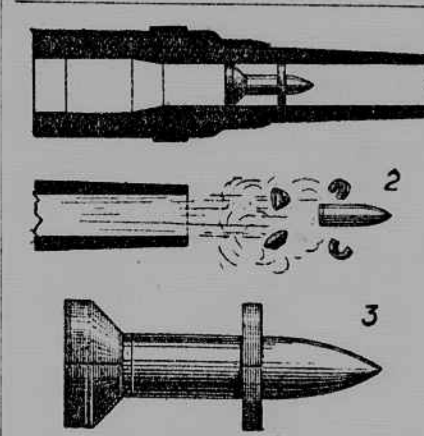
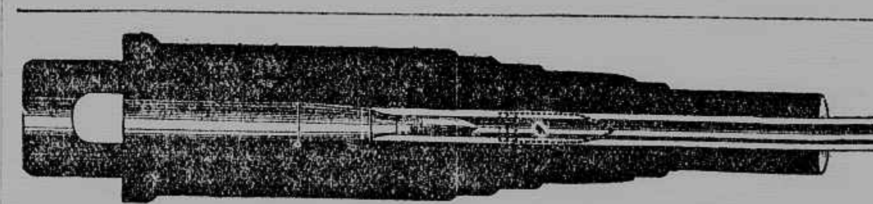


Fig. 7. The "sub-calibre" shell: the shell in the cannon; the shell after leaving the gun muzzle, with the movable pieces breaking off; the shell provided with its attachments

are now hiding in the Kiel Canal; such a gun has a length of 50 calibres, i. e., 20 yards. If we now will introduce a tube into the bore, thus bringing the calibre to 120, for example, the proportion to the new calibre of the same length of 20 yards will be about 150. Now, if the powder chamber will remain unchanged, the force exercised on the new projectile by the gas will be greater than before and the initial speed of the projectile will be very much increased.

"The process of introducing an additional tube into the bore of the gun is very simple. In this way it is not difficult to increase the range of the gun, and the mysterious cannon, the demoniac work of some barbarian genius, the monster, disappears and becomes nothing but a common engine of murder and assassination."



Diagrams from *La Nature*

Fig. 8. A cannon with a tube within its bore, which gives a very large powder chamber and a very great length in calibres

How "Old-Timers" Make Their Noggins

WALKING is one of the best exercises, but purposeless walking is abusing a good opportunity or misusing a chance to do something worth while. So when you go for a hike make a definite object for that hike. Make it an observation hike, a nature hike, a map-making hike, a plant hike, a tree hike or a "burling," says Dan Beard in "Boys' Life." "Burling" he explains as follows:

"Now, then, a burl, you know, is a scar on a tree covering a wound of some sort, generally where a small limb has died, rotted and been broken off short by the wind or weather, and good old Dame Nature has tried to heal the wound by covering the dead butt of the branch with a lump of live flesh, that is, of growing live wood. This makes a bump, 'bunion' or lump on the tree trunk, known as a burl, and a burl is the material from which real scouts fashion their noggins or drinking cups.

"Let us have the history of the noggin.

"A nodule is a little knot or lump; a nog or knag or knage is also a knot, also a little mug or pot. In olden times nogs or noggins were used for drinking, as, for instance, a noggin of ale, but you must remember that in ancient times wooden implements were used by the people in place of metal ones, and wooden porringers, wooden platters and wooden cups were common in the households of our ancestors.

"Some years ago, while on an exploring expedition with Mr. Arthur Rice, of the Campfire Club of America, I had occasion to note the advantages of a wooden cup carried by Mr. Rice, made from a burl or knot of wood. I had seen such cups before, but had to live with one to know its worth. After that I introduced its manufacture and use to the Boy Scouts and they popularized it, so that to-day the noggin, as we named this sort of cup, is known wherever outdoor people are to be found.

"Among the Campfire men we have a pretty bit of sentiment. The fellow who makes the cup must always present it to his bunkie, so each of us who owns a noggin carries with him not only our drinking cup, but also a souvenir of some jolly occasion and a prized gift from some boon companion."

They Know Which Way to Go

West Indian turtle catchers declare that newly hatched turtles possess an uncanny instinct of the direction in which the nearest water lies. Even when the eggs have been taken inland and hatched several miles from the sea, the little turtles will point in a direct line toward the salt water and at once begin to make their way toward it. —*Gas Logic.*

Concrete Ships Again

THE difficulties that have attended the building of concrete ships and the handicaps to their extensive use are pointed out in the following article in "The Illustrated World":

"No doubt exists that the concrete ship will function properly during the period, at least, when it is necessary to rush soldiers, munitions and supplies to Europe. The question, though, still is raised, 'How long may we expect a concrete ship to last?'

"That was naturally one of the first questions asked by the men who would be responsible for the inauguration of the concrete shipbuilding programme. It is safe to accept the belief that these same men did not plunge into the situation with their eyes closed. On the contrary, we may accept without reservation the statement that they obtained all the light possible on the subject from every available quarter.

"To that end the opinion of experts not only was sought, but bureaus of governmental departments were requested to make tests and report the feasibility of the whole project. The consensus of opinion and the results of experiments seemed to warrant the conclusion that a concrete vessel, properly constructed, should last for at least several years. . . .

"Unless unavoidable, direct current should not be employed on a concrete ship. This is because of the danger of electrolysis from stray current. The Bureau of Standards has demonstrated that a very slight leakage of sufficient duration will result in a weakening of the mortar at the cathode, with the consequence that the bond strength will be decreased. Or if the leakage of the electric current is fairly large an oxidation of the steel at the anode will follow. The penalty for this will be the splitting and chipping of the concrete.

"Another caution to avert trouble has to do with the kind of merchandise carried. There are certain materials that will tend to disintegrate the concrete. Among these are certain vegetable oils. Cocoanut and peanut oils are prominent in this category. Hence, where there is likelihood of employing the ship to carry such kind of cargo the inner surface of the hull should be protected with paint.

"Investigations are under way to find suitable coating material that will act as a protection against the deterioration of the concrete.

"Another problem was and still is that of the effects of rough seas. There is little 'give' in concrete, and hence there is the exposure of the vessel to sag and, to a lesser degree, torsion. A safe steel stress cracks when applied to concrete. This problem is now being diligently worked upon.

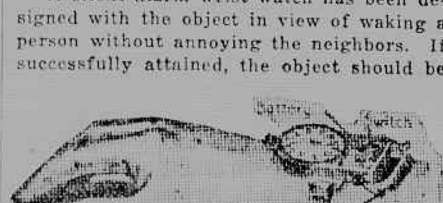
"As steel in considerable quantity is imbedded in the concrete, the question also arises how to protest it from corrosion. A large percentage of this can only be covered by a thin coating of mortar. Therefore, special means must be taken to take care of this situation. The steel may be galvanized or painted with some covering that will not in any marked degree affect the bond. An alternative is to coat the concrete with some material that will keep the steel surface free from both water and air. Here again tests are under way. . . .

"Then our old friend, the barnacle, long the plague of steel bottoms, and from time immemorial of wooden bottoms, has to be considered. This crustacean sticks to concrete bottoms, and some coating to prevent this has also to be evolved. A bituminous coating is a likely candidate for the ships of the government."

A Silent Alarm Watch

DID you ever lie awake all night while an alarm clock in the room ran like a thrashing machine? Were you ever awakened at 5 o'clock Sunday morning by the alarm bell of a neighbor off for a fishing trip? Then you will welcome the silent alarm watch described in "The Popular Science Monthly":

"A silent alarm wrist watch has been designed with the object in view of waking a person without annoying the neighbors. If successfully attained, the object should be



much appreciated in the average boarding house and is worthy of commendation. A current-heated wire about the wrist is supposed to scorch the sleeper sufficiently to make him open the switch, and he usually does so without wasting time in dreamland.

"The necessary current is supplied by a miniature battery, also worn on the wrist, and a small switch lever is inserted in a space beneath the watch crystal opposite the predetermined hour. When the hour hand has reached the proper point it closes the switch and scorches the victim prone to oversleeping.

"The alarm itself is undoubtedly silent, and it is just a question whether the yell emitted by the sleeper annoys the neighbors less than does the ordinary alarm clock.

"However, this wrist watch will prove invaluable at the battlefront, which demands heroic remedies for sleepiness."

—From *The London Graphic*

THE importance of bridges in the present war and the rôle they have played in previous ones is discussed by a writer in "The London Graphic," who points out that bridges have often decided the fates of armies and nations:

"Every observant railway traveller in these belligerent days has caught at least a fleeting glimpse of a sight unique in modern British history—the sight of a man in khaki on guard with fixed bayonet wherever the train passes over an important bridge. . . . In the battles of the Marne, the Aisne and the Piave, such structures were factors of vital moment; especially in connection with the former struggle, for it was the crossing of the Aisne which sealed the German defeat in that historic conflict. It was a fifteen-mile stretch of the Aisne, a deep and broad and unfordable stream, which the British had to cross, and that they were able to do so was due to the superhuman labors of the Royal Engineers in repairing in a single day five bridges and building nine more!

"Yet how little attention has been devoted to bridges in the records of the war, and how much less attention was given to their supreme importance in pre-war strategical study! . . .

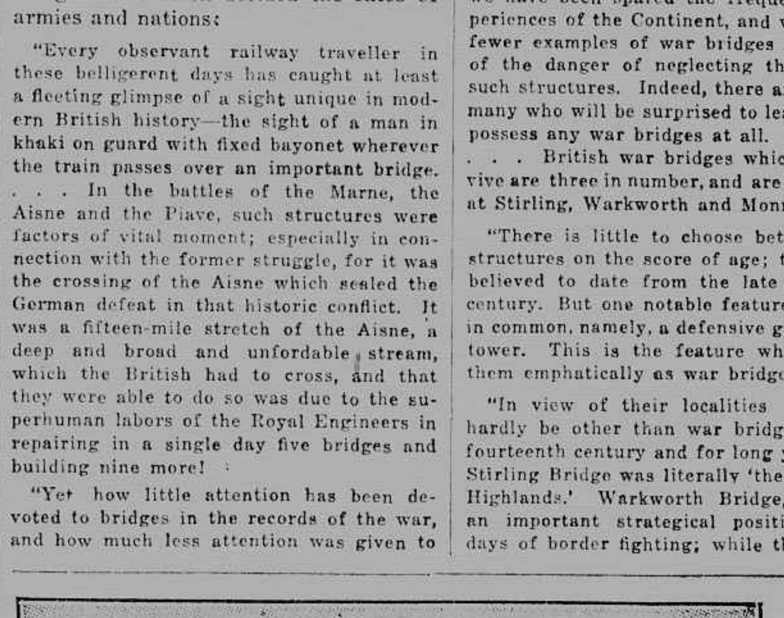
"This neglect is more excusable in Great Britain than on the Continent. Owing to our isolation from the European mainland, we have been spared the frequent war experiences of the Continent, and we have far fewer examples of war bridges to warn us of the danger of neglecting the study of such structures. Indeed, there are probably many who will be surprised to learn that we possess any war bridges at all. But we do. . . . British war bridges which still survive are three in number, and are to be found at Stirling, Warkworth and Monmouth.

"There is little to choose between these structures on the score of age; they are all believed to date from the late fourteenth century. But one notable feature they have in common, namely, a defensive gatehouse or tower. This is the feature which stamps them emphatically as war bridges.

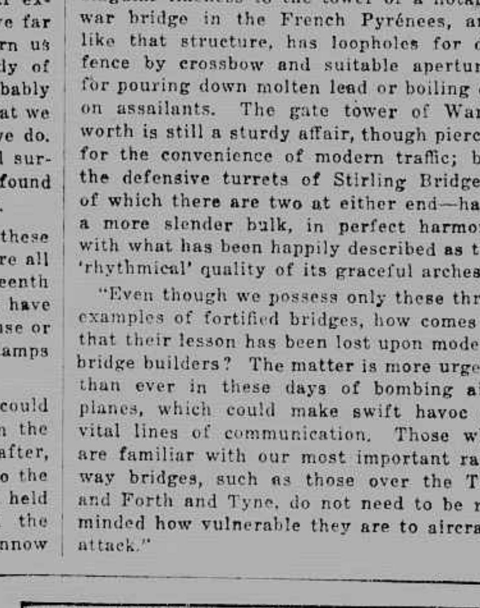
"In view of their localities they could hardly be other than war bridges. In the fourteenth century and for long years after, Stirling Bridge was literally 'the key to the Highlands.' Warkworth Bridge, too, held an important strategical position in the days of border fighting; while the Monnow Bridge at Monmouth commanded one of the most vital arteries of the West.

"Of the defensive towers of these unique bridges, that of the Monnow is the least changed and best preserved. It bears a singular likeness to the tower of a notable war bridge in the French Pyrénees, and, like that structure, has loopholes for defence by crossbow and suitable apertures for pouring down molten lead or boiling oil on assailants. The gate tower of Warkworth is still a sturdy affair, though pierced for the convenience of modern traffic; but the defensive turrets of Stirling Bridge—of which there are two at either end—have a more slender bulk, in perfect harmony with what has been happily described as the 'rhythmical' quality of its graceful arches.

"Even though we possess only these three examples of fortified bridges, how comes it that their lesson has been lost upon modern bridge builders? The matter is more urgent than ever in these days of bombing airplanes, which could make swift havoc of vital lines of communication. Those who are familiar with our most important railway bridges, such as those over the Tay and Forth and Tyne, do not need to be reminded how vulnerable they are to aircraft attack."



"The Key to the Highlands"—Stirling Bridge With Its Defensive Turrets



—Photos from *The London Graphic*

Warkworth Bridge as Defended in Olden Times

Lubricants

THE Austrians, it appears, are now extracting oils from the carcass of the cockchafer, as they do from bones, from fruit pips and from the refuse in sinks. This fact has inspired a writer in "Everybody's" to discuss at length the subject of lubricants, one of the numerous products of natural oil. He writes:

"Lubricants are not confined to oil. There are solid lubricants, like graphite and soapstone. There are half-solid lubricants, like tallow and vaseline; but, of course, the great lubricants are liquid oils. The uses of solids are restricted to very hard surfaces. The semi-solids, greases, are not as a rule used for surfaces which move at high speeds, though many greases which, in their normal state are almost solid, melt and act as oils between the surfaces they lubricate. We can regard them as liquids with high freezing points, if we wish, since they fulfil their rôle only as liquids. Liquid lubricants must be used with all fast moving bearings, and the more viscous they are the more suitable for bearings of low speed subject to great pressure. Such lubricants may be of mineral, vegetable or animal origin. Mineral oils are hydro-carbon compounds, and they are obtained by the distillation of petroleums in America, Russia, Galicia, Rumania and elsewhere.

"These natural supplies of oil come from certain rock strata where they are associated with gases. Being consequently under great pressure, a boring is no sooner sunk than the oil tends to be pumped out with the greatest violence. Odd-looking high derricks are built over the borings, so that an oil-producing country has a peculiar appearance that lives in the memory. From these great oil springs are obtained oils of varying properties, from heavy colza to the lighter naphtha and benzine, and they also give us petrol. It is not the paraffins which form the best lubricants, but the naphthenes, with their property of being unsaturated hydro-carbons. But lubricating qualities are also possessed by castor oil, olive oil and rape oil, which have this same property of being unsaturated compounds.

"It does not seem to the present writer that the chemistry of lubricating oils has been a very fruitful subject of inquiry as yet. Of course, it is easy to start from actual experience, and, having found what compounds are good lubricators, to proceed to analyze them and record their properties. But apparently the only chemical property so far discovered is that of being unsaturated, and this means that these substances combine with other substances by addition. They are not merely like the bulk of chemical compounds—more or less unstable, with a tendency to change one of their components for a component of another substance. They are simply unsatisfied and tend to add on other substances. Thus, if we take the hydro-carbon ethylene and treat it with hydrochloric acid the result is ethyl chloride, which is simply composed of the two added together with nothing over. Compare this with the hydro-carbon marsh gas, which, when the gas chlorine is added, forms methyl chloride and hydrochloric acid. It drops an atom of hydrogen and substitutes an atom of chlorine.

"But the properties needed in a lubricant are physical. Why do we use lubricants at all? Most people will readily answer, to make machinery go more easily. We may put this more scientifically by expressing it as the desire to lessen the friction between moving surfaces, and so to get more value out of some motive power. This is not all of the subject, for we also wish to lessen the wear and tear between the surfaces. The physics of lubricants is sometimes expressed as the substitution of liquid for solid friction, for whenever a lubricant is used the frictional wear and tear is transferred to it. The more solid set of lubricants seem to interpose between the moving surfaces a sort of series of rollers, and all lubricants interpose some sort of separating surface. Oils separate by the film which they make, and they are said to have more or less 'body' in proportion as they are capable of maintaining a film. It is this property that distinguishes a lubricant from any other liquid which is just as viscous. Oiliness, again, is a way of describing this film-maintaining property, and unless an oil is 'oily' enough to maintain a film between the moving parts when the loads are most heavy its uses are restricted. Animal and vegetable oils and fats are more 'oily,' have more 'body,' than mineral oils; but sometimes mixtures are used, and this presumably is where our poor cockchafer comes in. Animal oils and fats are exceedingly scarce in the Central Empires. Vegetable oils come mostly from tropical countries, where we are doing our best to stimulate cultivation at present. Seed, such as hempseed and sunflower seed, yields a certain quantity of vegetable oil in Germany, and every one is being encouraged to grow sunflowers at present.

"The form of the surfaces which meet has, of course, much to do with friction, and lubrication would be a much more difficult problem if it were not for the fact that cylindrical bearings are what the chemist has most to provide for. But the nature of the problem would not be correctly gauged if we did not realize that a good lubricant can diminish the friction between surfaces as much as 2,000 times, and the energy lost is directly proportioned to the friction in the same way that the wearing of bearings depends directly upon the effectiveness of the lubricants in keeping the moving surface separate from the supporting and guiding surface."